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In re the Application of:

Kenji MORIWAKI, et al.

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For: RESIN MATERIAL REMOLDING METHOD AND RESIN MATERIAL PULVERIZED PIECE SELECTING APPARATUS

SUBMISSION OF VERIFIED ENGLISH TRANSLATIONS

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Sir:

Subsequent to the Amendment filed September 8, 2006, attached hereto are Verified English Translations of applicant's priority documents JP 2003-041259 (filed on February 19, 2003) and JP 2003-138170 (filed on May 16, 2003).

If there are any formal matters remaining after this response, the Examiner is requested to telephone the undersigned to attend to these matters.

If there are any additional fees associated with filing of this Amendment, please charge the same to our Deposit Account No. 19-3935.

Respectfully submitted,

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DECLARATION

I, Shuji Kimura, residing at 7 th Fl., Shuwa Kioicho Park Bldg., 3-6, Kioicho, Chiyoda-ku, Tokyo, Japan, hereby declare that I have a thorough knowledge of Japanese and English languages, and that the attached pages contain correct translations into English of the application documents of Japanese Patent Applications No. 2003-041259 filed on February 19, 2003 and No. 2003-138170 filed on May 16, 2003, in the names of Mazda Motor Corporation and Satake Corporation.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made, are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signed this 11th day of September, 2006.

Shuji Kimura

Translation of Japanese Patent Application No. 2003-041259

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[Title of The Invention]	COATING FILM PEELING AND SEPARATING METHOD AND SEPARATING APPARATUS FOR USE IN THE METHOD
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[List of attached documents]

[Classification]	Specification	1
[Classification]	Drawing(s)	1
[Classification]	Abstract	1

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[TYPE OF DOCUMENT] Specification

[TITLE OF THE INVENTION] COATING FILM PEELING AND SEPARATING METHOD AND SEPARATING APPARATUS FOR USE IN THE METHOD

[WHAT IS CLAIMED IS:]

[Claim 1]

A coating film peeling and separating method comprising:

a pulverizing step of pulverizing a coated resin molded product into pulverized pieces;

a peeling step of peeling coating films of the pulverized pieces;

a classification step of classifying the pulverized pieces into a plurality of groups in accordance with the particle diameter of the pulverized piece and allowing the pulverized pieces to fall in accordance with the particle diameter after the peeling step;

a sensing step of sensing coating film-remaining products of the falling pulverized pieces by using an photosensor; and

a separating step of separating the coating film-remaining products and non-coating film products based on a result of sensing in the sensing step.

[Claim 2]

The coating film peeling and separating method

according to claim 1, wherein the pulverizing step pulverizes the coated resin molded product at random by a cutting tool having a rotary blade.

[Claim 3]

The coating film peeling and separating method according to claim 1, wherein the sensing step senses the coating film on the basis of a difference from a background color different from a coating film color.

[Claim 4]

The coating film peeling and separating method according to claim 1, the sensing step senses the coating film of the falling pulverized pieces in one direction and another direction by the photosensor.

[Claim 5]

The coating film peeling and separating method according to claim 1, wherein when the sensing step senses the coating film-remaining product, the separating step performs the separation by blowing a gas against the falling product to change a falling direction.

[Claim 6]

The coating film peeling and separating method according to claim 1, wherein the coated resin molded product is a used automobile part.

[Claim 7]

A separating apparatus comprising:

classifying means placed in a charge port of

pulverized pieces of a coated resin molded product which is pulverized and a coating film of which is peeled, for classifying the pulverized pieces into a plurality of groups in accordance with particle diameters of the pulverized pieces;

a plurality of chutes allowing the classified pieces to fall in accordance with the particle diameters;

a photosensor sensing coating film-remaining products of the falling pulverized pieces; and

separating means for separating the coating film-remaining products and non-coating film products based on a result of sensing by the photosensor.

[Claim 8]

The separating apparatus according to claim 7, wherein said classifying means is a screening device for classifying the pulverized pieces.

[Claim 9]

The separating apparatus according to claim 7, further comprising a background member having a background color different from a coating film color, wherein the coating film-remaining product of the falling pulverized pieces is sensed on the basis of a difference from the background color.

[Claim 10]

The separating apparatus according to claim 7, further comprising gas blowing means for, when the

coating film-remaining product is sensed, blowing a gas against the falling product to change a falling direction, wherein the separation is performed by direction change caused by air-blowing.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[TECHNICAL FIELD OF THE INVENTION]

The present invention relates to a coating film peeling and separating method and separating apparatus for use in the method which pulverize coated resin molded products upon recycling it, peel a coating film from the pulverized piece, and separate the pulverized pieces into non-coating film products and the coating film-remaining products.

[0002]

[Prior Art]

Generally, when coated resin molded products such as resin bumpers as automobile parts are to be recycled, if a coating film remains as foreign matter in this resin, the resin cracks from this portion when an external force is applied to the resin. In addition to this physical property problem, the external appearance worsens.

[0003]

Accordingly, it is being desired to perform recycling by using only a resin having no coating film as foreign matter.

To reuse plastic molded products, therefore, a plastic recycling method which recycles plastic molded products by peeling a coating film has already been invented.

[0004]

That is, this plastic recycling method includes a fine plastic piece formation step of forming a plate-like fine piece aggregate (i.e., fine pieces) of coated plastic molded products, a coating film peeling step of peeling the coating film from the coated fine plastic pieces by rubbing using a mechanical force to obtain a fine piece/powder mixture of the fine pieces from which the coating film is peeled and the coating film powder, and a fine piece/powder separation step of separating this fine piece/powder mixture into the fine pieces from which the coating film is peeled and the coating film powder (see Patent Document 1 as an example).

[0005]

[Patent Document 1]

Japanese Patent Laid-Open No. 2001-353721

[0006]

[PROBLEMS THAT THE INVENTION IS TO SOLOVE]

In this method disclosed in the document, the coating film is peeled from the coated plastic molded product caused by rubbing action using the mechanical force. However, it is practically very difficult to

completely peel the coating film only with the rubbing action using the mechanical force. If the coating film peeling process described above is continued, the particle diameter of the plastic fine piece may become too small and the amount of them may be excessively reduced. Consequently, recycle molding cannot be well performed, or the resin collection ratio largely decreases.

[0007]

The present invention is made on the basis of the novel findings that a substantial coating film removal ratio effectively increases by separating non-coating film products and coating film-remaining products which have been not completely peeled in a peeling process of a coating film, and has as its object to provide a coating film peeling and separating method and separating apparatus for use in the method which pulverize a coated resin molded product into pulverized pieces, peel coating films of the pulverized pieces, classify the pulverized pieces into a plurality of groups in accordance with the particle diameter (or particle size) and allow the pulverized pieces to fall in accordance with the particle diameter, sense coating film-remaining products of the falling pulverized pieces by using an photosensor, and separate the coating film-remaining products and non-coating film products, thereby preventing a decrease of sensing

accuracy which may be caused when the pulverized pieces have various sizes and therefore, the coating film-remaining product of small-particle-diameter is hidden behind the non-coating film product of large-particle-diameter upon sensing, and allowing rapid and easy execution of the series of sensing and separating steps because the sensing is performed during falling.

[0008]

[MEANS OF SOLVING THE PROBLEMS]

A coating film peeling and separating method according to the present invention, comprises a pulverizing step of pulverizing a coated resin molded product into pulverized pieces, a peeling step of peeling coating films of the pulverized pieces, a classification step of classifying the pulverized pieces into a plurality of groups in accordance with the particle diameter of the pulverized piece and allowing the pulverized pieces to fall in accordance with the particle diameter after the peeling step, a sensing step of sensing coating film-remaining products of the falling pulverized pieces by using an photosensor, and a separating step of separating the coating film-remaining products and non-coating film products based on a result of sensing in the sensing step.

[0009]

The falling can be natural falling, and the photosensor can be a sensor such as a CCD camera.

According to the method, a coated resin molded product into pulverized pieces in the pulverizing step, coating films of the pulverized pieces are peeled in the peeling step, and the pulverized pieces are classified into a plurality of groups in accordance with the particle diameter of the pulverized piece and are allowed to fall in accordance with the particle diameter in the classification step after the peeling step.

[0010]

Coating film-remaining products (coating film-remaining pulverized pieces)of the falling pulverized pieces are sensed by using an photosensor in the sensing step, and in the separating step, the coating film-remaining products and non-coating film products (non-coating pulverized pieces) are separated based on a result of sensing in the sensing step.

[0011]

Especially, the pulverized pieces are classified into the plurality of groups in accordance with the particle diameter of them and are allowed to fall in accordance with the particle diameter, thereby easily preventing a decrease of sensing accuracy which may be caused when the pulverized pieces have various sizes and therefore, the coating film-remaining product of

small-particle-diameter is hidden behind the non-coating film product of large-particle-diameter upon sensing. Additionally, the series of sensing and separating steps can be executed rapidly and easily because the sensing is performed while the coating film-remaining products and the non-coating film products are falling.

[0012]

According to an embodiment of the present invention, the pulverizing step pulverizes the coated resin molded product at random by a cutting tool having a rotary blade.

In the embodiment, although the coated resin molded product is pulverized at random, adequate sensing and selecting can be performed because the random pulverized pieces are classified into the plurality of groups in accordance with the particle diameter and fall in accordance with the particle diameter.

[0013]

According to another embodiment of the present invention, the sensing step senses the coating film on the basis of a difference from a background color different from a coating film color.

In the embodiment, since the coating film is sensed using the background color different from the coating film color, there becomes no erroneous sensing

and sensing accuracy of the coating film is easily and effectively improved.

[0014]

According to still another embodiment of the present invention, the sensing step senses the coating film of the falling pulverized pieces in one direction and another direction by the photosensor.

In the embodiment, since sensing is performed in at least two directions at different angles, the coating film-remaining products can be adequately sensed nevertheless a falling attitude of the pulverized piece.

[0015]

According to still another embodiment of the present invention, when the sensing step senses the coating film-remaining product, the separating step performs the separation by blowing a gas against the falling product to change a falling direction.

[0016]

The gas can be an air.

In the embodiment, since the falling direction of the coating film-remaining product is changed by blowing a gas, the coating film-remaining products and the non-coating film products are separated by a simple method.

[0017]

According to still another embodiment of the

present invention, the coated resin molded product is a used automobile part.

The automobile part in the embodiment can be a coated resin molded product such as a bumper, front grill, mirror housing, or spoiler.

[0018]

In the above arrangement, the used automobile part can be recycled through pulverization, coating film peeling, and separating.

[0019]

A separating apparatus according to the present invention, comprises classifying means placed in a charge port of pulverized pieces of a coated resin molded product which is pulverized and a coating film of which is peeled, for classifying the pulverized pieces into a plurality of groups in accordance with particle diameters of the pulverized pieces, a plurality of chutes allowing the classified pieces to fall in accordance with the particle diameters, a photosensor sensing coating film-remaining products of the falling pulverized pieces, and separating means for separating the coating film-remaining products and non-coating film products based on a result of sensing by the photosensor.

[0020]

According to the apparatus, when the coated resin molded product (i.e. pulverized pieces) which is

pulverized and a coating film of which is peeled is charged to the charge port, the classifying means classifies the pulverized pieces into a plurality of groups in accordance with particle diameters of the pulverized pieces, the plurality of chutes allow the classified pieces to fall in accordance with the particle diameters respectively, the photosensor senses coating film-remaining products of the falling pulverized pieces, and separating means separates the coating film-remaining products and non-coating film products based on a result of sensing by the photosensor.

[0021]

As described above, the pulverized pieces are classified into the plurality of groups in accordance with the particle diameter by the classifying means and are allowed to fall to different chutes in accordance with the classified particle diameter respectively , thereby easily preventing a decrease of sensing accuracy which may be caused when the pulverized pieces have various sizes and therefore, the coating film-remaining product of small-particle-diameter is hidden behind the non-coating film product of large-particle-diameter upon sensing. Additionally, the series of sensing and separating steps can be executed rapidly and easily because the sensing is performed while the coating film-remaining products and the non-

coating film products are falling.

[0022]

According to an embodiment of the present invention, said classifying means is a screening device for classifying the pulverized pieces.

In the embodiment, classification can be appropriately performed by a simple apparatus. The screening device is an apparatus which uses a screen or porous plate having meshes of a predetermined size, and classifies (screens) the pulverized pieces into those which pass through the meshes and those which do not.

[0023]

According to another embodiment of the present invention, the apparatus further comprises a background member having a background color different from a coating film color, and the coating film-remaining product of the falling pulverized pieces are sensed on the basis of a difference from the background color.

[0024]

In the embodiment, since the coating film is sensed using the background color different from the coating film color, there becomes no erroneous sensing, and sensing accuracy of the coating film is easily and effectively improved.

[0025]

According to still another embodiment of the present invention, the apparatus further comprises gas

blowing means for, when the coating film-remaining product is sensed, blowing a gas against the falling product to change a falling direction, wherein the separation is performed by direction change caused by air-blowing.

[0026]

The gas blowing means can be air blowing means such as a air nozzle.

In the embodiment, since the falling direction of the coating film-remaining product is changed by blowing a gas, the coating film-remaining products and the non-coating film products are separated by a simple structure.

[0027]

[EMBODIMENTS]

An embodiment of the present invention will now be described in detail in accordance with the accompanying drawings.

These drawings illustrate a coating film peeling and separating method and a separating apparatus for use in the method. First, the arrangement of an apparatus for use in the coating film peeling and separating method will be described below with reference to Figs. 1 to 5. For the sake of convenience of explanation, used automobile parts are resin bumpers in the following embodiment.

[0028]

Fig. 1 shows a pulverizer 3 for pulverizing a coated resin molded product 1 (resin bumper) into pulverized pieces 2. The pulverizer 3 has a cutter mill 6 as a cutting tool in a pulverization space 5 which continues to a charge port 4. A plurality of rotary blades 7 are integrated with the outer circumferential surface of the cutter mill 6, and a screen 8 is placed below the cutter mill 6. The coated resin molded product 1 charged into the pulverization space 5 is coarsely pulverized at random by rotating the cutter mill 6 in the direction of an arrow, and the pulverized pieces 2 are allowed to fall through the meshes of the screen 8.

[0029]

The pulverized pieces 2 have various sizes, and the coating film has not been peeled from the pulverized pieces 2. Therefore, a coating film b is sticking to a resin a. In the drawing, the resin a is hatched, and the coating film b is blanked.

[0030]

Fig. 2 shows a coating film peeling apparatus 9 for peeling the coating film b from the resin a of the pulverized pieces 2 obtained by the pulverizer 3 shown in Fig. 1. In the coating film peeling apparatus 9, a plurality of blades 12 are attached to a rotary member 11 formed on the inner bottom surface of a peeling bath 10. A driving unit 13 having a built-in motor is

placed below the peeling bath 10. When the pulverized pieces 2 are charged into the peeling path 10 and the rotary member 11 is rotated, the coating film b of the pulverized pieces 2 is peeled by the blades 12.

[0031]

As shown in Fig. 3, the pulverized pieces 2 processed by the coating film peeling apparatus 9 contain non-coating film products (to be simply referred to as OK products hereinafter) A from which the coating film b is completely removed, and coating film-remaining products (to be simply referred to as NG products hereinafter) B having the coating film b remaining on the resin a.

[0032]

Fig. 3 shows a separating apparatus 14 for performing classification and separation for the pulverized pieces 2 processed by the coating film peeling apparatus 9 shown in Fig. 2.

The separating apparatus 14 includes a material charge port 15 for charging the pulverized pieces 2 having various sizes and containing both the OK products A and NG products B,

a conveyor 16 for conveying upward the pulverized pieces 2 charged through the material charge port 15,

a conveyor 18 formed between the upper portion of the conveyor 16 and a position above a charge port 17a of a hopper 17 to supply the pulverized pieces 2 into

the hopper 17a,

a screening device 19 formed inside the hopper 17 below the charge port 17a to function as a classifying means for classifying the pulverized pieces 2 into a plurality of groups in accordance with the particle diameter (or particle size),

two chutes 20 and 21 for naturally dropping the pulverized pieces 2 classified by the screening device 19 separately as small pulverized pieces 2S and large pulverized pieces 2L,

a sensor 23 placed below the chutes 20 and 21 to sense the NG products B of the falling pulverized pieces 2,

a separator 24 placed below the sensor 23 to separate the NG products B and the OK products A, and

collection tanks 25 and 26 formed below the separator 24 to separately collect the NG products B and OK products A, respectively.

[0033]

The screening device 19 has a screen or porous plate 19b having meshes 19a of a predetermined size, and screens the pulverized pieces 2 charged from the charge port 17a into the small pulverized pieces 2S which pass through the meshes 19a and the large pulverized pieces 2L which do not pass through the meshes 19a. The small pulverized pieces 2S thus screened naturally fall into the chute 20, and the

large pulverized pieces 2L naturally fall into the chute 21.

In this embodiment, the pulverized pieces 2 are classified into two sizes, i.e., the small pulverized pieces 2S and large pulverized pieces 2L for the sake of illustrative convenience. However, the pulverized pieces 2 may also be classified into three or more sizes.

[0034]

Fig. 4 is an enlarged view for explaining the sensor 23 and collection tanks 25 and 26 shown in Fig. 3. The sensor 23, separator 24, and collection tanks 25 and 26 used for the small pulverized pieces 2S naturally falling in the chute 20 are the same as those used for the large pulverized pieces 2L naturally falling in the chute 21, so the operation of one of these systems will be explained in detail below.

[0035]

As shown in Fig. 4, the chute 20 is inclined at a predetermined angle from the lower portion of the hopper 17 toward the collection tank 26. A chute extended portion 27 is formed on the extension line of the chute 20. Also, a chute branched portion 28 for guiding the NG products B to the collection tank 25 is branched from the middle portion of the chute extended portion 27.

[0036]

A sensing space 29 is formed between the lower end of the chute 20 and the upper end of the chute extended portion 27. Instead of the sensing space 29, a colorless, transparent intermediate chute may also be used to connect the lower end of the chute 20 and the upper end of the chute extended portion 27.

[0037]

A CCD sensor 30 as an photosensor and a background member 31 in background color, e.g., black, different from the coating film color oppose each other in positions above and below the sensing space 29.

[0038]

The CCD sensor 30 is a photosensor for sensing the NG products B of the naturally falling pulverized pieces 2 from the front of the chute (i.e., in one direction).

To sense the NG products B in another direction, i.e., at an angle different from that of the CCD sensor 30, a CCD sensor 32 as another photosensor and a background member 33 in background color, e.g., black, different from the coating film color oppose each other in positions below and above the sensing space 29.

The CCD sensor 32 is a photosensor for sensing the NG products B of the naturally falling pulverized products 2 from the back of the chute (i.e., in the other direction).

[0039]

A pair of color fluorescent lamps 34, 34 as illuminating means are arranged near the image sensing lens of each of the CCD sensors 30 and 32. The color of light emitted from the color fluorescent lamps 34 is desirably green in order to reduce sensing errors.

[0040]

In addition, an ejector 36 having a plurality of air-blow holes 35 (Fig. 5) is formed over the entire width of the falling flow path of the pulverized pieces 2, so as to oppose the upper end opening of the chute branched portion 28. When the CCD sensor 30 or 32 senses an NG product B, an air-blow nozzle 37 blows air as a gas against the falling NG product B in synchronism with the falling timing of the NG product B, thereby changing the course of falling from the chute extended portion 27 to the chute branched portion 28 for separating.

[0041]

As shown in Fig. 5, when the CCD sensor 30 or 32 senses an NG product B, air is blown from a specific air-blow hole 35a of the ejector 36 in synchronism with the timing at which the NG product B falls to a position in front of the ejector 36. As shown in Fig. 4, the course of the NG product B is changed to the chute branched portion 28, and the NG product B is thus separated. If the size of an NB product B is large, air is blown from a plurality of corresponding

air-blow holes 35 at the same time.

[0042]

The coating film peeling and separating method will be described below with reference to a flow chart shown in Fig. 6.

In collection step S1, used coated resin molded products 1 (resin bumpers) are collected.

[0043]

In pulverization step S2, the coated resin molded products 1 are pulverized into pulverized pieces 2 by the pulverizer 3 shown in Fig. 1. That is, the coated resin molded products 1 are charged into the pulverizing space 5 from the charge port 4 of the pulverizer 3, and coarsely pulverized at random by the rotary blades 7 by the rotation of the cutter mill 6.

After pulverization step S2, the coating film b is sticking to the resin a of the pulverized pieces 2, and the pulverized pieces 2 have various sizes.

[0044]

In peeling step S3, the coating film b is peeled from the pulverized pieces 2. That is, the pulverized pieces 2 obtained in pulverization step S2 are charged into the peeling bath 10 of the coating film peeling apparatus 9 shown in Fig. 2, and the coating film b is peeled from the resin a by the blades 12 by driving the rotary member 11.

[0045]

In classification step S4, the pulverized pieces 2 (including the OK products A and NG products B)from which the coating film is peeled are classified in accordance with the particle diameter.

Thus, the pulverized pieces 2 obtained upon peeling step S3 are charged into the material charge port 15 of the separating apparatus 14 shown in Fig. 3. The charged pulverized pieces 2 are conveyed from the charge port 17a of the hopper 17 onto the screening device 19 via the conveyors 16 and 18. The pulverized pieces 2 are screened (classified) into small pulverized pieces 2S which pass through the meshes 19a and large pulverized pieces 2L which do not pass through the meshes 19a by horizontally reciprocating the porous plate 19b of the screening device 19.

[0046]

The small pulverized pieces 2S having passed through the meshes 19a naturally fall in the chute 20, and the large pulverized pieces 2L not having passed through the meshes 19a naturally fall in the chute 21. That is, it is possible to classify the pulverized pieces 2 in accordance with the particle diameter or particle size, and allow the thus classified pulverized pieces 2 to fall in the chutes 20 and 21 in accordance with the particle diameter.

[0047]

While the pulverized pieces 2 are naturally

falling after the completion of classification step S4, sensing step S5 and separating step S6 are successively executed.

In sensing step S5, while the pulverized pieces 2 are naturally falling, from the chute 20 to the chute extended portion 27 shown in Fig. 4, the falling NG products B are sensed by using the background member 31 and CCD sensor 30, or the background member 33 and CCD sensor 32, opposing each other on the two sides of the sensing space 29.

[0048]

If the CCD sensor 30 or 32 sense the NG product B, an image processing is performed for an output of the CCD sensor 30 or 32, and a signal is output to the corresponding air-blow nozzle 37.

[0049]

In separating step S6, according to an output signal of the CCD sensor 30 or 32, air is blown from the specific air-blow hole 35a (see Fig. 5) at the timing at which the NG product B falls in front of the ejector 36, thereby changing the course of fall of the NG product B from the chute extended portion 27 to the chute branched portion 28, i.e., separating the NG products B to be air-blown and the OK products not to be air-blown.

[0050]

The OK products A the course of fall of which are

not changed are collected from the chute extended portion 27 into the collection tank 26, and the NG products B the course of fall of which are changed are collected from the chute branched portion 28 to the another collection tank 25.

[0051]

The OK products A (i.e., the pulverized pieces 2 having no residual coating film b) collected in the collection tank 26 are formed into resin pellets by using an extruder in recycled material extrusion step S7. In molding step S8, the resin pellets are reused as they are molded into products such as resin bumpers by using an injection molder.

[0052]

On the other hand, the NG products B (i.e., the pulverized pieces 2 having the residual coating film b) collected in the collection tank 25 are reused as they are molded into low-grade products (e.g., automobile parts used in positions where they cannot be seen from the outside) through steps S7 and S8.

[0053]

The processing time in peeling step S3 described above is desirably not too short and not too long. Fig. 7 shows measurement data indicating the relationship between the processing time of peeling step S3, the residual coating film area, and the frequency. Referring to Fig. 9, the frequency of

pulverized pieces 2 having no coating film is indicated by a hatched bar; the frequency of pulverized pieces 2 having a residual coating film area exceeding 50 mm^2 is indicated by a solid bar; the frequency of pulverized pieces 2 having a residual coating film area of 10 to 50 mm^2 is indicated by a blank bar; and the frequency of pulverized pieces 2 having a residual coating film area of less than 10 mm^2 is indicated by a dotted bar.

[0054]

As shown in Fig. 7, when the processing time exceeds 60 min (see bars of 65 min), not only the processing time is excessively long, but also the base material (see resin a) reduces in weight to decrease the collection ratio.

[0055]

To avoid this, setting is performed such that a predetermined amount of NG products B having a certain area of the coating film b remain (see bars of 15 and 40 min). In this case, the NG products B are reliably sensed and separated in sensing step S5 and separating step S6, so the processing time can be shortened. In addition, the reduction in weight of the base material (see resin a) also decreases, and this increases the collection ratio. If the processing time is less than 15 min, the coating film b which is originally removable also remains, so the coating film removal ratio worsens. Therefore, the processing time of

peeling step S3 is desirably 15 to 60 min.

[0056]

Fig. 8 is a graph showing the relationship between the coating film peeling time and the coating film removal ratio. A characteristic c indicates the characteristic of this embodiment including steps S2 to S6. A characteristic d indicates the characteristic of a conventional example having only steps S2 and S3.

[0057]

As shown in the graph of Fig. 8, this embodiment can greatly increase the coating film removal ratio because the pulverized pieces 2 are classified, the NG products B are sensed, and the OK products A and the NG products B are separated. To set the coating film removal ratio at a higher target value, the coating film peeling time is desirably set between 26 and 60 min.

[0058]

As described above, the coating film peeling and separating method of the above embodiment, comprises the pulverizing step S2 of pulverizing the coated resin molded product 1 into pulverized pieces 2, the peeling step S3 of peeling coating films b of the pulverized pieces 2, the classification step S4 of classifying the pulverized pieces 2 into a plurality of groups in accordance with the particle diameter of the pulverized piece 2 and allowing the pulverized pieces 2 to fall in

accordance with the particle diameter after the peeling step S3, the sensing step S5 of sensing coating film-remaining products (see the NG products B) of the falling pulverized pieces 2 by using an photosensor(see CCD sensor 30, 32), and the separating step S6 of separating the coating film-remaining products (see the NG products B)and non-coating film products (see the OK products A) based on a result of sensing in the sensing step S5.

[0059]

According to the method, the coated resin molded product 1 into pulverized pieces in the pulverizing step S2, coating films of the pulverized pieces are peeled in the peeling step S3, and the pulverized pieces are classified into a plurality of groups in accordance with the particle diameter of the pulverized piece and are allowed to fall in accordance with the particle diameter in the classification step S4.

[0060]

The coating film-remaining products (see the NG products B) of the falling pulverized pieces are sensed by using the photosensor (see the CCD sensor 30, 32) in the sensing step, and in the separating step S6, the coating film-remaining products (see the NG products B) and non-coating film products (see the OK products A) are separated.

[0061]

Especially, in the classification step S4 the pulverized pieces 2 are classified into the plurality of groups in accordance with the particle diameter of them and are allowed to fall in accordance with the particle diameter, thereby easily preventing a decrease of sensing accuracy which may be caused when the pulverized pieces 2 have various sizes and therefore, the coating film-remaining product of small-particle-diameter (see the small pulverized piece S2)is hidden behind the non-coating film product of large-particle-diameter (see the large pulverized piece L2) upon sensing. Additionally, the series of sensing and separating steps can be executed rapidly and easily because the sensing is performed while the coating film-remaining products (see the NG products)and the non-coating film products (see the OK products) are falling.

[0062]

The pulverizing step S2 pulverizes the coated resin molded product 1 at random by a cutting tool (see the cutter mill 6) having rotary blades 7.

In the arrangement, although the coated resin molded product 1 is pulverized at random, adequate sensing and selecting can be performed because the random pulverized pieces 2 are classified into the plurality of groups in accordance with the particle diameter and fall in accordance with the particle

diameter in the classification step S4.

[0063]

The sensing step S5 senses the coating film on the basis of a difference from a background color (see the background member 31, 33)different from a coating film color.

In the arrangement, since the coating film is sensed using the background color different from the coating film color, there becomes no erroneous sensing and sensing accuracy of the coating film is easily and effectively improved.

[0064]

The sensing step S5 senses the coating film b of the falling pulverized pieces 2 in one direction and another direction by the photosensor (see the CCD sensors 30 and 32.

In the arrangement, the coating film b of the pulverized piece 2 is sensed in at least two directions at different angles, the coating film-remaining products (see the NG products B) can be adequately sensed nevertheless a falling attitude of the pulverized piece 2.

[0065]

When the sensing step S5 senses the coating film-remaining product (see the NG product B), the next step S6 performs the separation by blowing a gas (see the air) against the falling product to change a falling

direction.

[0066]

In the arrangement, since the falling direction of the coating film-remaining product (see the NG product B) are changed by blowing a gas, the coating film-remaining products (see the NG products) and the non-coating film products (see the OK products) are separated by a simple method.

[0067]

The coated resin molded product 1 is a used automobile part.

The automobile part can be a coated resin molded product such as a front grill, mirror housing, or spoiler other than the bumper as described above.

[0068]

In the above arrangement, the used automobile part can be recycled through pulverization, coating film peeling, and separating.

[0069]

The separating apparatus 14 of the embodiment comprises classifying means (see the screening device 19) placed in the charge port 17a of pulverized pieces 2 of a coated resin molded product (see the pulverized pieces 2) which is pulverized and a coating film of which is peeled, for classifying the pulverized pieces 2 into a plurality of groups in accordance with particle diameters of the pulverized pieces 2, a

plurality of chutes 20 and 21 allowing the classified pulverized pieces 2 to fall in accordance with the particle diameters, a photosensor (see the CCD sensor 30, 32) sensing coating film-remaining products (see the NG products B) of the falling pulverized pieces 2, and separating means (see the separator 24) for separating the coating film-remaining products (see the NG products B) and non-coating film products (see the OK products A) based on a result of sensing by the photosensor.

[0070]

According to the apparatus, when the coated resin molded product (i.e. the pulverized pieces 2) which is pulverized and a coating film of which is peeled is charged to the charge port 17a , the classifying means (see the screening device 19) classifies the pulverized pieces 2 into a plurality of groups in accordance with particle diameters of the pulverized pieces, the plurality of chutes 20 and 21 allow the classified pulverized pieces 2 to fall in accordance with the particle diameters respectively, the photosensor (see the CCD sensor 30, 32) senses coating film-remaining products (see the NG products B) of the falling pulverized pieces 2, and separating means (see the separator 24) separates the coating film-remaining products (see the NG products B) and non-coating film products (see the OK products A) based on a result of

sensing by the photosensor.

[0071]

As described above, the pulverized pieces are classified into the plurality of groups in accordance with the particle diameter by the classifying means (see the screening device 19) and are allowed to fall to different chutes 20 and 21 in accordance with the classified particle diameter respectively , thereby easily preventing a decrease of sensing accuracy which may be caused when the pulverized pieces 2 have various sizes and therefore, the coating film-remaining product of small-particle-diameter is hidden behind the non-coating film product of large-particle-diameter upon sensing. Additionally, the series of sensing and separating steps can be executed rapidly and easily because the sensing is performed while the coating film-remaining products (see the NG products B) and the non-coating film products (see the OK products A) are falling.

[0072]

The classifying means is the screening device 19 for classifying the pulverized pieces 2.

In the arrangement, classification can be appropriately performed by a simple apparatus. The screening device 19 is an apparatus which uses a screen or porous plate 19b having meshes 19a of a predetermined size, and classifies (screens) the

pulverized pieces into those which pass through the meshes 19a and those which do not.

[0073]

The apparatus further comprises the background members 31 and 33 having a background color different from a coating film color, and the coating film-remaining product (see the NG products B) of the falling pulverized pieces 2 are sensed on the basis of a difference from the background color.

[0074]

In the arrangement, since the coating film is sensed using the background color different from the coating film color, there becomes no erroneous sensing, and sensing accuracy of the coating film is easily and effectively improved.

[0075]

The apparatus further comprises gas blowing means (see the air-blow nozzle 37)for, when the coating film-remaining product (see the NG product B) is sensed, blowing a gas (see the air) against the falling product to change a falling direction, wherein the separation is performed by direction change caused by air-blowing.

[0076]

In the arrangement, since the falling direction of the coating film-remaining product (see the NG product B) is changed by blowing a gas, the coating film-remaining products (see the NG products B) and the

non-coating film products (see the OK products A) are separated by a simple structure.

[0077]

Fig. 9 shows another embodiment of the separating method and the apparatus. This embodiment shown in Fig. 9 eliminates sensing errors by sensing a wavelength unique to titanium oxide TiO_2 as a white pigment, or a wavelength unique to chlorine Cl as a component of a primer (primer: undercoating of painting) below black painting, by using fluorescent X-rays.

[0078]

To achieve this, the embodiment shown in Fig. 9 has the following apparatus in addition to the arrangement shown in Fig. 4.

That is, a lower chute 41 is formed below the inclined lower end portion of a chute extended portion 27 with a sensing space 40 being interposed between them. In addition, a lower chute branched portion 42 connects a middle portion of the lower chute 41 and a middle portion of a chute branched portion 28.

[0079]

OK products A falling through a chute 20, the chute extended portion 27, and the lower chute 41 are collected by a collection tank 26. NG products B whose course is changed to the chute branched portion 28 and lower chute branched portion 42 are collected by a

collection tank 25.

[0080]

Also, an ejector 36 and air-blow nozzles 37 are arranged to oppose the upper end opening of the lower chute branched portion 42. The arrangements of the elements 36 and 37 are the same as shown in Figs. 4 and 5.

[0081]

This embodiment also includes an X-ray lamp 43 for emitting X-rays e to detect an NG product B from pulverized pieces 2 falling in the sensing space 40. Fluorescent X-rays f excited from the pulverized pieces 2 irradiated with the X-rays e are separated into spectral components by a spectral crystal 44. A CCD sensor 45 having an X-ray sensing function is an X-ray sensing means for sensing only X-rays g having a specific wavelength.

[0082]

As shown in Fig. 9, fluorescent X-ray analyzers 46 using the above-mentioned fluorescent X-ray analyzing method are installed on the two sides of the sensing space 40.

Titanium oxide TiO_2 as a white pigment is detected at the wavelength of titanium Ti. Therefore, the spectral crystal 44 is so chosen as to separate the X-rays g at the wavelength of titanium Ti = 4.508 Å. To detect chlorine Cl as a primer component, the

spectral crystal 44 is so chosen as to separate the wavelength of chlorine Cl = 2.621 Å.

[0083]

To prevent sensing errors by performing only separating step on the basis of lightness, saturation, or hue when the CCD sensor 45 senses the specific X-rays g, the air-blow nozzle 37 on the side of the fluorescent X-ray analyzer 46 is driven at the timing at which an NG product B falls to the position of the ejector 36, thereby changing the course of fall of the NG product B containing titanium Ti or chlorine Cl from the lower chute 41 to the lower chute branched portion 42.

[0084]

This arrangement makes it possible to prevent sensing errors and greatly increase the coating film removal ratio.

In the embodiment shown in Fig. 9, the rest of the arrangements, functions, and effects is substantially the same as in the previous embodiment. Therefore, the same reference numerals as in the previous drawings denote the same parts in Fig. 9, and a detailed description thereof will be omitted. However, it is, of course, also possible to switch the positions of the sensing/separation section using color and the sensing/separation section using the fluorescent X-ray analyzers 46 shown in Fig. 9. That

is, the fluorescent X-ray analyzers 46 may also be arranged upstream of the sensing/separation section using color.

[0085]

Fig. 10 shows still another embodiment of the separating method and the apparatus. This embodiment uses an optical bandpass filter (so-called BPF) 47 for passing only X-rays having a specific wavelength, and an X-ray sensor 48 for sensing X-rays g of the specific wavelength passing through the BPF 47 and converting the X-rays g into an electrical signal, instead of the spectral crystal 44 and the CCD sensor 45 having an X-ray sensing function in the embodiment shown in Fig. 9.

Fluorescent X-ray analyzers 49 each made up of an element 43, the BPF 47, and the X-ray sensor 48 are arranged on the two sides of a sensing space 40.

[0086]

Titanium oxide TiO_2 as a white pigment is detected at the wavelength of titanium Ti. Therefore, the BPF 47 is so selected as to separate the X-rays g at the wavelength of titanium Ti = 4.508 Å. To detect chlorine Cl as a primer component, the BPF 47 is so selected as to separate the wavelength of chlorine Cl = 2.621 Å.

[0087]

This arrangement also achieves substantially the

same functions and effects as in the embodiment shown in Fig. 9. Accordingly, the same reference numerals as in Fig. 9 denote the same parts in Fig. 10, and a detailed explanation thereof will be omitted.

[0088]

The coating film peeling apparatus used in peeling step S3 shown in Fig. 6 may also be the following apparatus, instead of the apparatus shown in Fig. 2.

That is, a coating film b made of a thermosetting resin can be peeled from a thermoplastic resin a such as polypropylene by using a mechanical peeling apparatus having a rotary blade on the bottom of a bath. In this apparatus, the coating film b is peeled by using a difference between the resin a which is easy to bend and the coating film b which is hard to bend by applying shear stress to a pulverized piece 2 at the softening temperature of the resin a as a base material.

[0089]

It is also possible to use an apparatus (so-called cone press) which peels the coating film b from the resin a by applying a compressive force to a pulverized piece 2 in a slit between a fixed cone and liner by using vibrating compression, shearing force, and surface polishing produced between the fixed cone and liner, thereby lowering the adhesion of the coating

film b.

[0090]

In addition, a shot peening apparatus or shot blasting apparatus which peels the coating film b by impact by peening or blasting the surface of a pulverized piece 2 with shots (small spheres).

[0091]

The arrangements of the present invention correspond to the aforementioned embodiments as follows.

That is, a coated resin molded product of the invention corresponds to the resin bumper of the embodiments.

Likewise,

a coating film-remaining product corresponds to the NG product B,

a non-coating film product corresponds to the OK product A,

a photosensor corresponds to the CCD sensors 30 and 32,

a cutting tool used in a pulverization step corresponds to the cutter mill 6,

a background color corresponds to the background members 31 and 33,

a charge port corresponds to the charge port 17a in the upper portion of the hopper 17,

separating means corresponds to the separator 24,

classifying means corresponds to the screening device 19,

gas blowing means corresponds to the air-blow nozzle 37.

However, the present invention is not limited to the above embodiment.

[0092]

[EFFECT OF THE INVENTION]

The present invention is made on the basis of the novel findings that a substantial coating film removal ratio effectively increases by separating non-coating film products and coating film-remaining products which have been not completely peeled in a peeling process of a coating film. The present invention pulverizes a coated resin molded product into pulverized pieces, peels coating films of the pulverized pieces, classifies the pulverized pieces into a plurality of groups in accordance with the particle diameter (or particle size) and allows the pulverized pieces to fall in accordance with the particle diameter, senses coating film-remaining products of the falling pulverized pieces by using an photosensor, and separates the coating film-remaining products and non-coating film products. Therefore, the present invention has an effect to prevent a decrease of sensing accuracy which may be caused when the pulverized pieces have various sizes and therefore, the coating film-remaining

product of small-particle-diameter is hidden behind the non-coating film product of large-particle-diameter upon sensing, and allow rapid and easy execution of the series of sensing and separating steps because the sensing is performed during falling.

[BRIEF DESCRIPTION OF DRAWINGS]

[Fig.1]

A view for explaining a pulverizer for use in a step before coating film peeling

[Fig.2]

A view for explaining a coating film peeling apparatus

[Fig.3]

A view for explaining a separating apparatus

[Fig.4]

An enlarged side view of the main components shown in Fig. 3

[Fig.5]

A view for explaining an air-blow portion

[Fig.6]

A flow chart showing a separating method

[Fig.7]

A graph showing the relationship between the processing time, residual coating film area, and frequency

[Fig.8]

A graph showing the relationship between the

coating film peeling time and coating film removal ratio;

[Fig.9]

A sectional view showing another embodiment of the separating method and its apparatus

[Fig.10]

A sectional view showing still another embodiment of the separating method and its appratus

[DESCRIPTION OF REFERENCENUMERALS]

A OK product

B NG product

b coating film

1 coated resin molded product

2 pulverized piece

6 cutter mill (cutting tool)

7 rotary blade

17a charge port

19 screening device (classifying means)

20, 21 chute

24 separator (separating means)

30, 32 CCD sensor (photosensor)

31, 33 back ground member

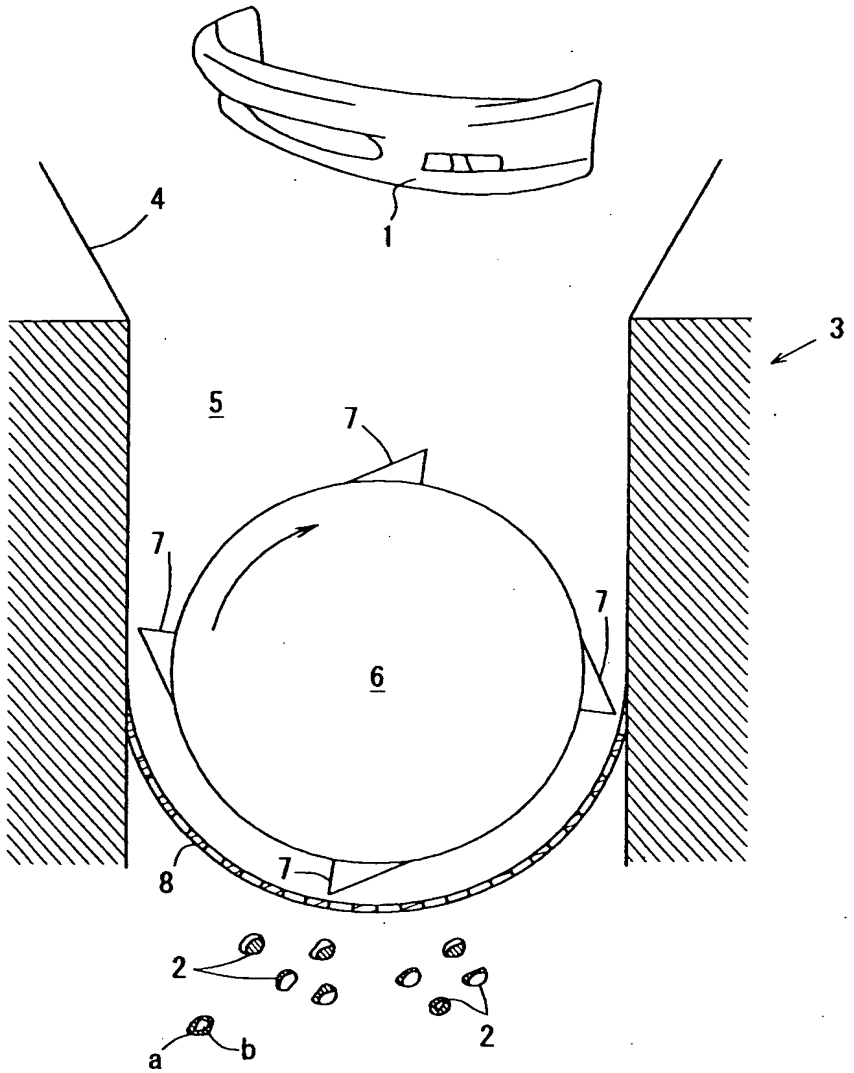
37 air-blow nozzle (air blowing means)

[TYPE OF DOCUMENT] Drawings

【書類名】　図面

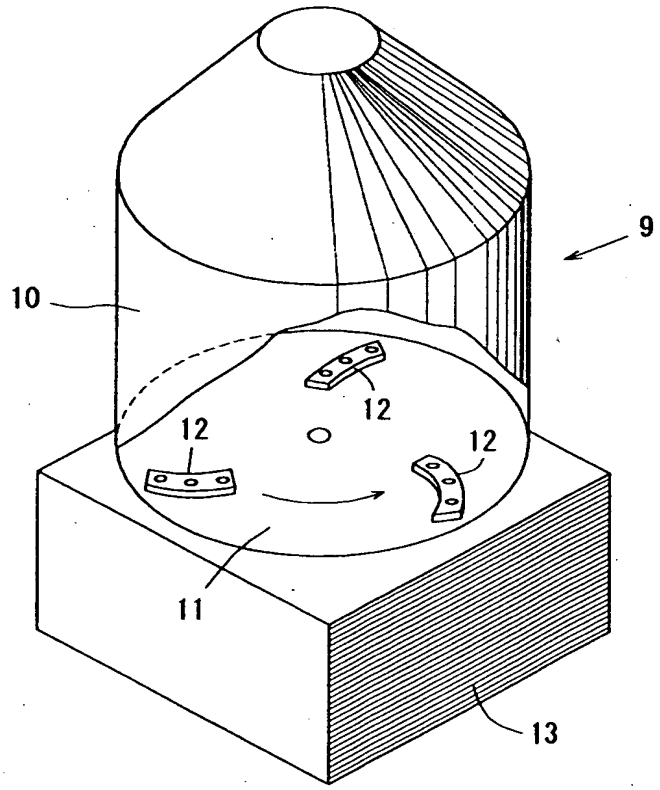
【図１】

[FIG. 1]

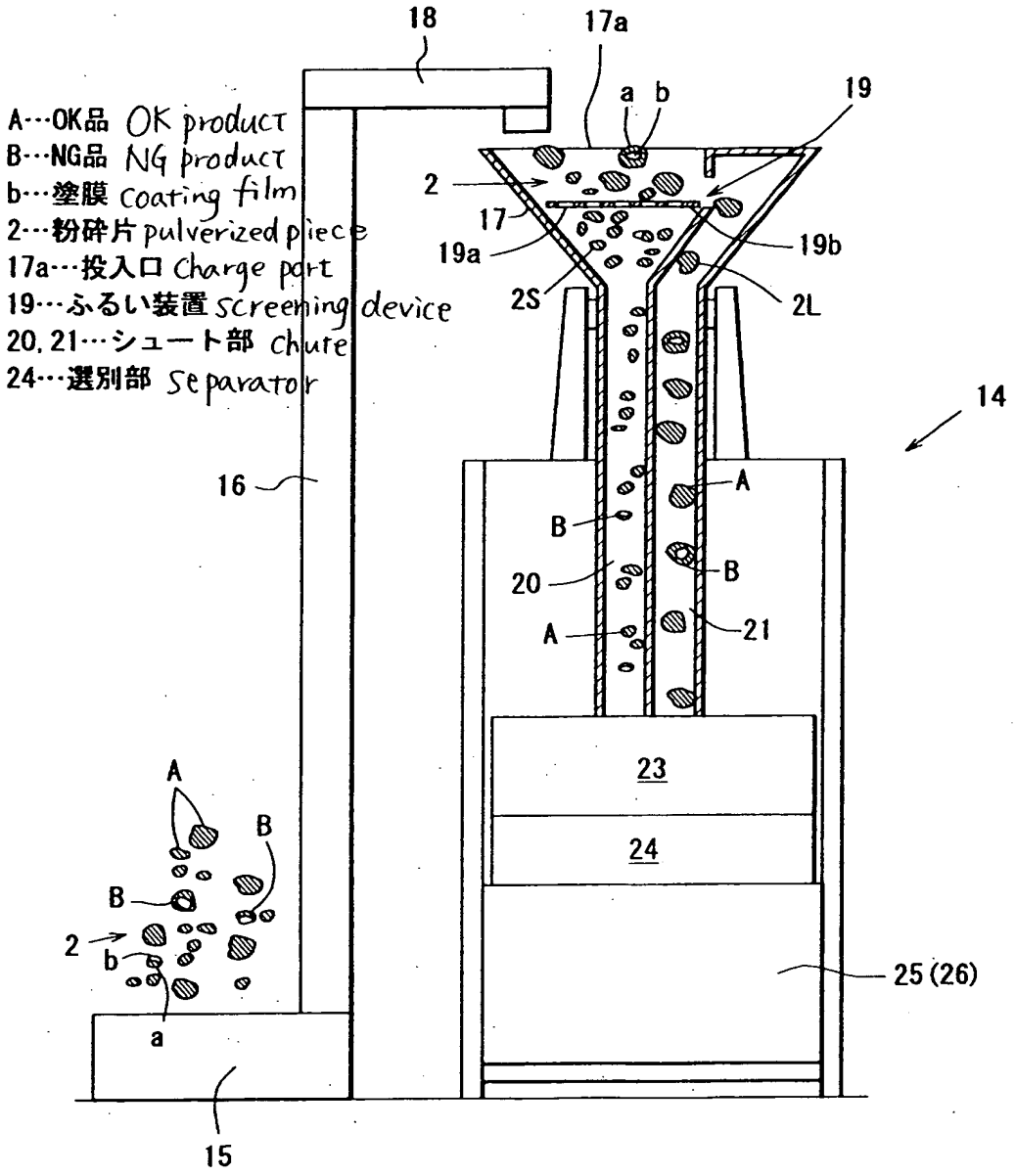


2…粉砕片 pulverized piece
b…塗膜 coating film
6…カッターミル cutter mill
1…塗膜付き樹脂成形品
7…回転刃 rotary blade
coated resin molded product

【図２】
[FIG. 2]

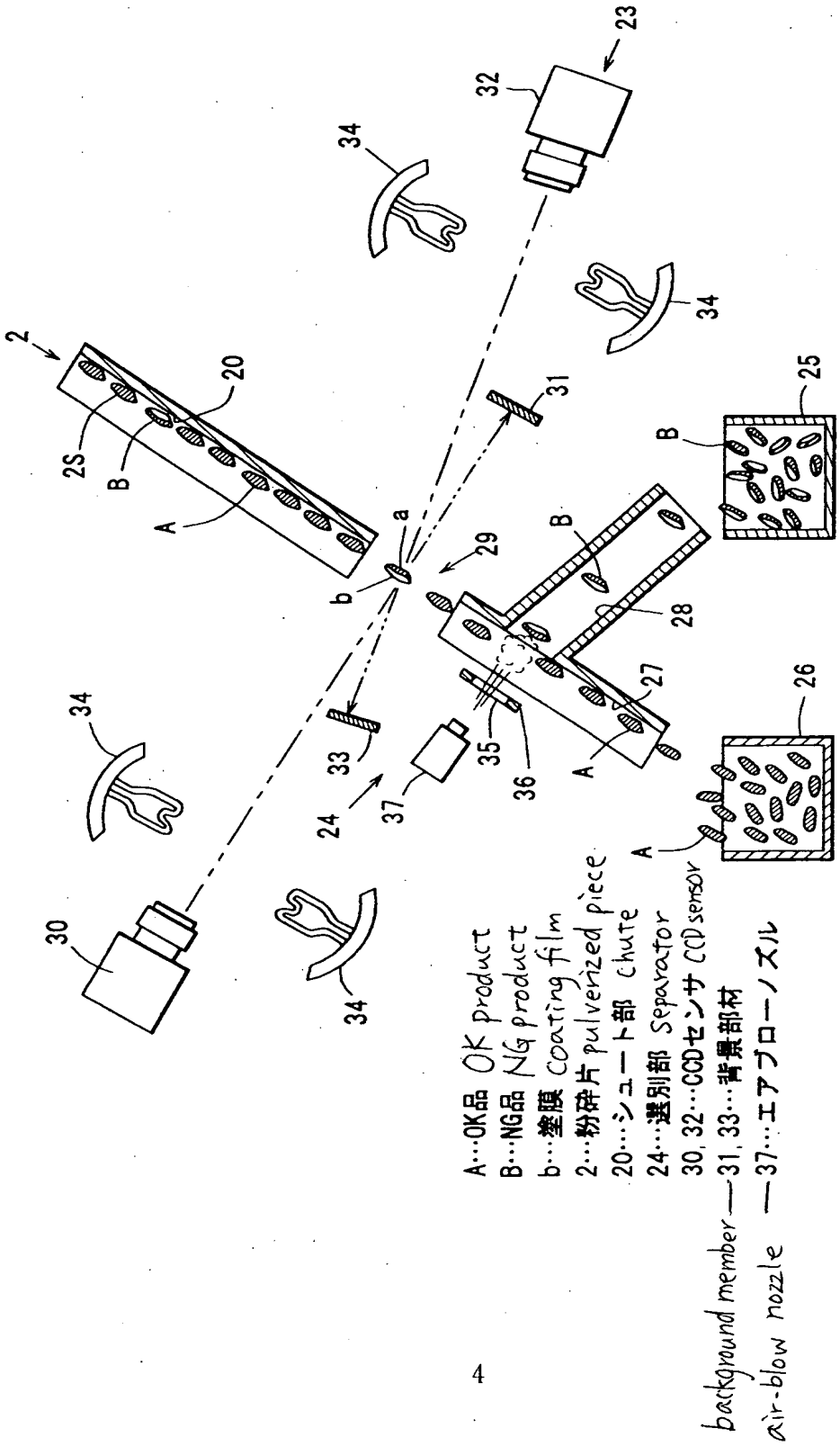


【図３】
[FIG. 3]


A…OK品 OK product
B…NG品 NG product
b…塗膜 coating film
2…粉砕片 pulverized piece
17a…投入口 charge port
19…ふるい装置 screening device
20, 21…シュート部 chute
24…選別部 separator
18
17a
a
b
19
2
17
19a
19b
2S
2L
14
16
A
B
20
21
23
24
25 (26)
15

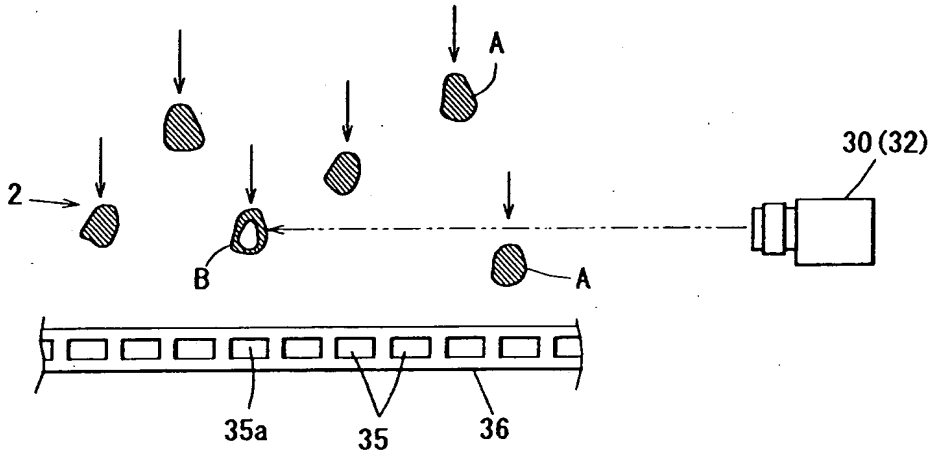
【図４】

[FIG. 4]


A…OK品 OK product
B…NG品 NG product
b…塗膜 coating film
2…粉砕片 pulverized piece
20…シュート部 chute
24…選別部 Separator
30, 32…CCDセンサ CCD sensor
31, 33…背景部材 background member
37…エアブローノズル air-blow nozzle

【図５】

[FIG. 5]



A…OK品 OK product
B…NG品 NG product
2…粉砕片 pulverized piece
30, 32…CCDセンサ CCD sensor

【図６】

[FIG. 6]

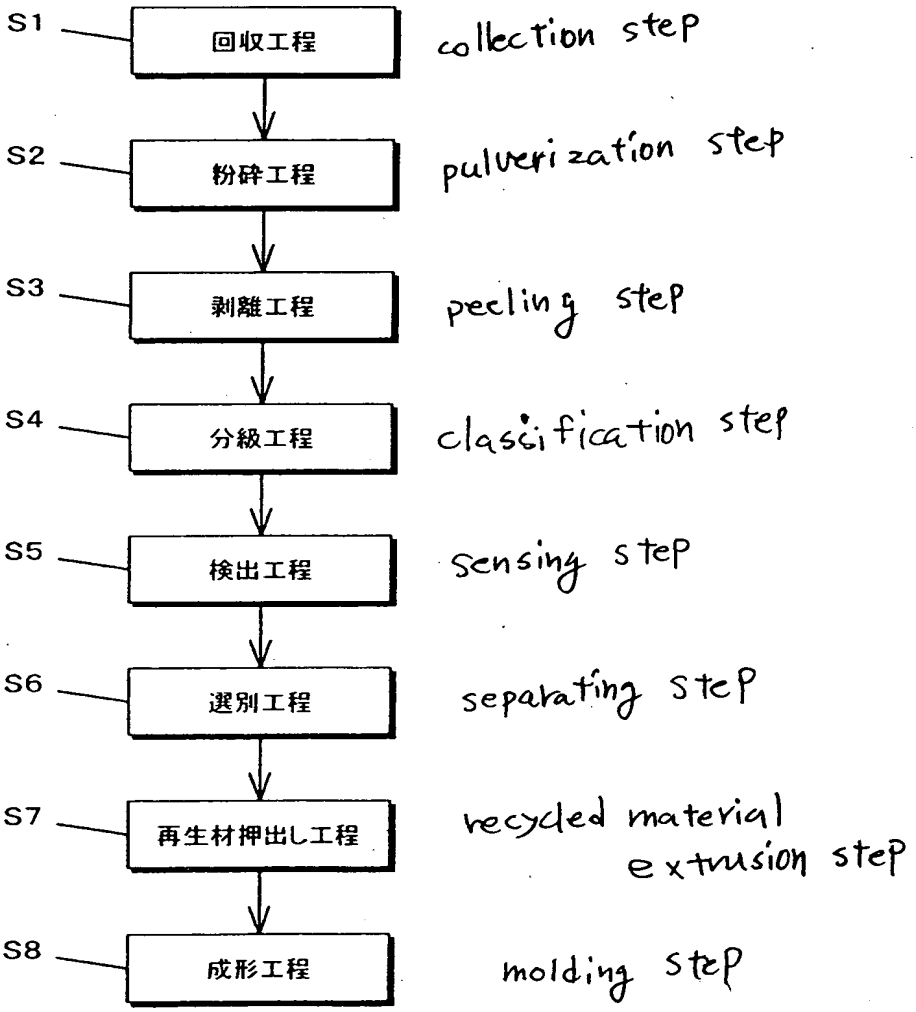

S1
回収工程
collection step
S2
粉砕工程
pulverization step
S3
剥離工程
peeling step
S4
分級工程
classification step
S5
検出工程
sensing step
S6
選別工程
separating step
S7
再生材押出し工程
recycled material extrusion step
S8
成形工程
molding step

FIG. 7

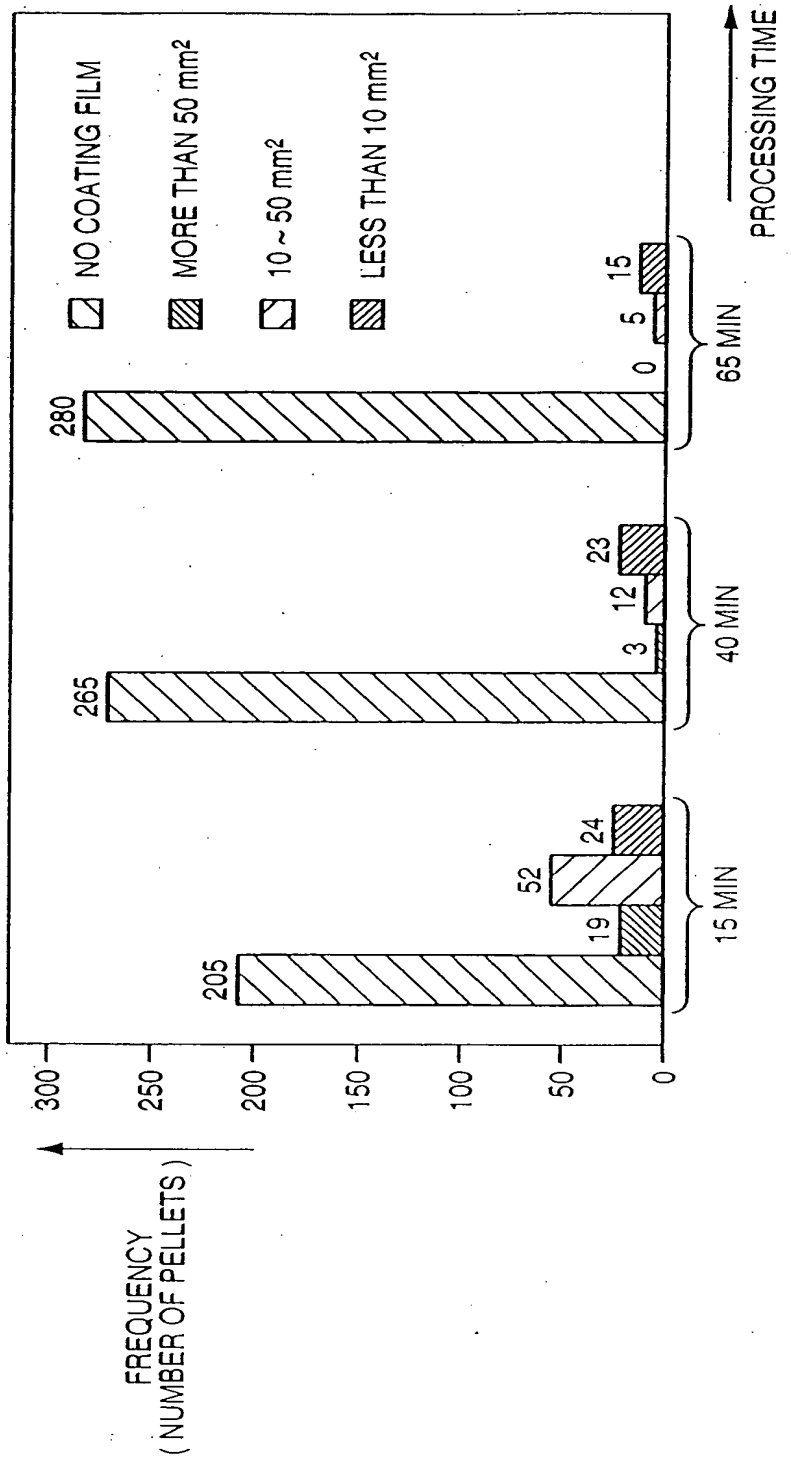
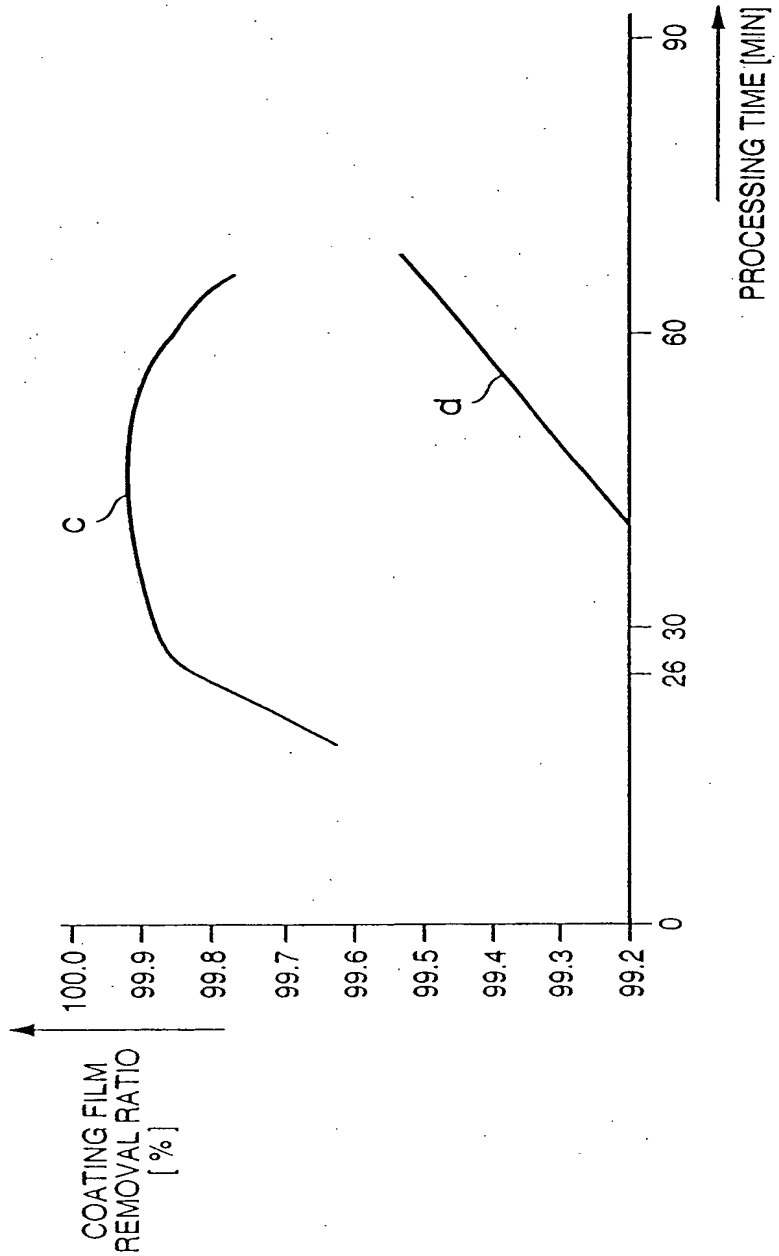
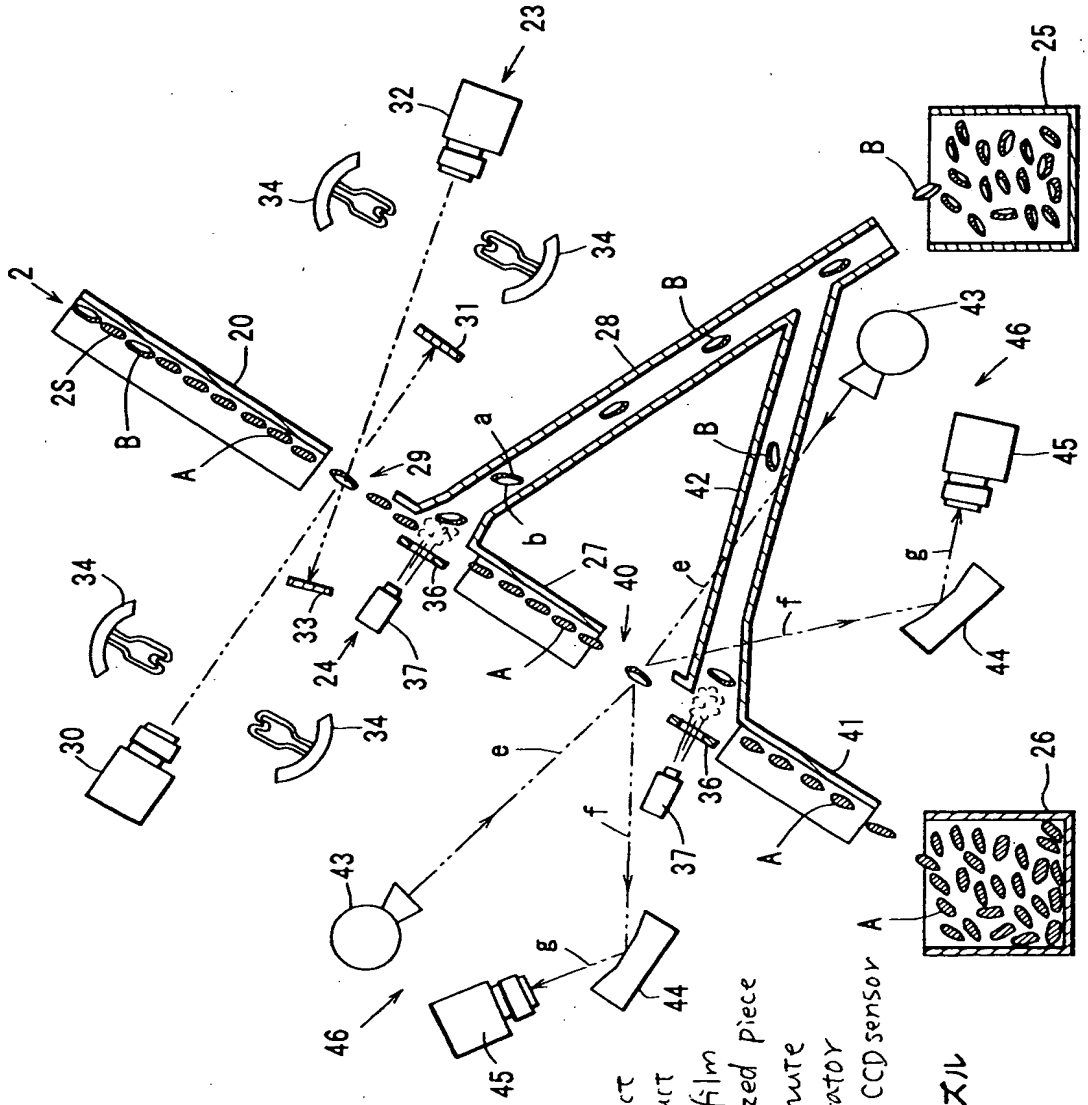

NO COATING FILM
MORE THAN 50 mm²
10 ~ 50 mm²
LESS THAN 10 mm²
FREQUENCY
(NUMBER OF PELLETS)
300
250
200
150
100
50
0
205
19
52
24
265
3
12
23
280
0
5
15
15 MIN
40 MIN
65 MIN
PROCESSING TIME

FIG. 8

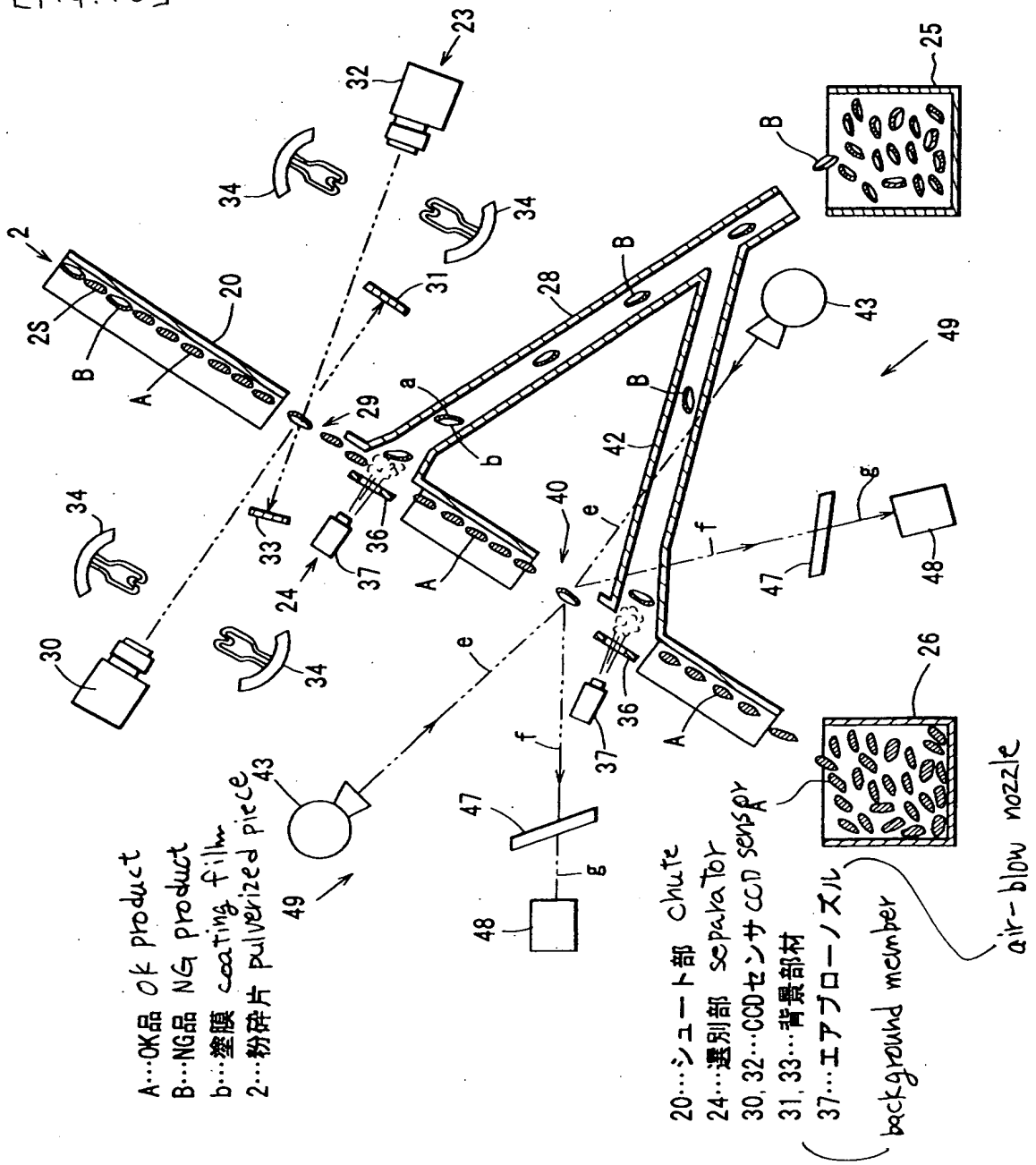

COATING FILM REMOVAL RATIO [%]
100.0
99.9
99.8
99.7
99.6
99.5
99.4
99.3
99.2
0
26
30
60
90
PROCESSING TIME [MIN]
c
d

【図９】
[FIG. 9]


A…OK品 OK product
B…NG品 NG product
b…塗膜 coating film
2…粉砕片 pulverized piece
20…シュート部 chute
24…選別部 separator
30, 32…CCDセンサ CCD sensor
background member — 31, 33…背景部材
air-blow nozzle — 37…エアブローノズル

【図１０】

[FIG. 10]


A…OK品 OK product
B…NG品 NG product
b…塗膜 coating film
2…粉砕片 pulverized piece
20…シュート部 chute
24…選別部 separator
30, 32…CCDセンサ CCD sensor
31, 33…背景部材
37…エアブローノズル
background member
air-blow nozzle

[TYPE OF DOCUMENT] ABSTRACT OF DISCLOSURE

[ABSTRACT]

[OBJECT] The present invention is made on the basis of the novel findings that a substantial coating film removal ratio effectively increases by separating non-coating film products and coating film-remaining products which have been not completely peeled in a peeling process of a coating film, and has as its object to provide a coating film peeling and separating method and separating apparatus for use in the method which pulverize a coated resin molded product into pulverized pieces, peel coating films of the pulverized pieces, classify the pulverized pieces into a plurality of groups in accordance with the particle diameter (or particle size) and allow the pulverized pieces to fall in accordance with the particle diameter, sense coating film-remaining products of the falling pulverized pieces by using an photosensor, and separate the coating film-remaining products and non-coating film products, thereby preventing a decrease of sensing accuracy which may be caused when the pulverized pieces have various sizes and therefore, the coating film-remaining product of small-particle-diameter is hidden behind the non-coating film product of large-particle-diameter upon sensing, and allowing rapid and easy execution of the series of sensing and separating steps because the sensing is performed

during falling.

[MEANS OF SOLVING THE PROBLEM] The feature is to comprise a pulverizing step S2 of pulverizing a coated resin molded product into pulverized pieces, a peeling step S3 of peeling coating films of the pulverized pieces, a classification step S4 of classifying the pulverized pieces into a plurality of groups in accordance with the particle diameter of the pulverized piece and allowing the pulverized pieces to fall in accordance with the particle diameter after the peeling step, a sensing step S5 of sensing coating film-remaining products of the falling pulverized pieces by using an photosensor, and a separating step S6 of separating the coating film-remaining products and non-coating film products based on a result of sensing in the sensing step.

[SELECTED DRAWING] FIG. 6